

Clinical and Diagnostic Findings in Patients with Lumbar Radiculopathy and Polyneuropathy

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Abstract

Background

When lumbar radiculopathy and polyneuropathy occur together a complex situation that is capable of causing disability occurs. Physicians need to be able to recognize when these conditions present together and know how to diagnose and treat them.

Methods

The clinical signs and symptoms, electrodiagnostic findings, and lumbar spine imaging in 70 patients with lumbar radiculopathy and polyneuropathy were analyzed.

Results

Precisely 27% of patients with lumbar radiculopathy were diagnosed with polyneuropathy of the lower extremities. Patient reports of bilateral neuropathic symptoms with findings of bilateral distal muscle weakness, distal decreased sensation to sharp pin, and ankle reflex diminishment were the most consistent indicators of a polyneuropathy in addition to the lumbar radiculopathy.

Conclusion

If a patient with low back pain presents with bilateral neuropathic symptoms and signs in the lower extremities, imaging studies and electrodiagnostic studies are recommended to diagnose and treat the radiculopathy and polyneuropathy.

Introduction

The dominant medical factors associated with the development of disability in patients with low back pain is the presence of severe leg pain and a history of prior episodes of low back pain.^{1,2} In patients presenting with leg pain greater than low back pain,

lumbar radiculopathy and stenosis are described as the most common etiologies.^{3,4} Lumbar radiculopathy refers to a pathologic process involving the lumbar nerve roots causing radicular symptoms into a lower extremity. The nerve root pathology arises primarily from direct neural compression irrespective of whether the etiology is an acute herniated or displaced disc, bony spurs, foraminal stenosis, central stenosis, or hypermobility of a vertebral segment.⁵ The prevalence of lumbar radiculopathy varies from about 2.2% to 8% and the incidence ranges from 0.7% to 9.6%.⁶

Despite the large number of nerve roots subject to potential compromise in the lumbosacral region, approximately 76.1% of lumbar radiculopathies involve the L5 and S1 nerve roots.⁵ L5 and S1 radiculopathy results in sensory loss over the dorsum and lateral foot and weakness of ankle and toe extensors and flexors. Although most radiculopathies result in unilateral symptoms, lumbar central canal stenosis can result in single, bilateral, and multilevel lesions which cause bilateral symptoms. Neurogenic claudication with bilateral leg pain, numbness, tingling, weakness, and muscle cramping radiating into the feet upon activity can be symptoms of lumbar stenosis.^{7,8} However, patients with radiculopathy and stenosis usually present with low back pain and unilateral more than bilateral leg pains, numbness, and weakness. Physical exam most commonly reveals reduced lumbar range of motion, lumbar paraspinal muscle spasm, and lower extremity muscle weakness, sensory loss, and reflex changes associated with a L4, L5, or S1 radicular pattern.³

Diagnosis of lumbar radiculopathy is particularly challenging due to the anatomy involved. In the lumbar spine, the dorsal and ventral lumbar roots exit the spinal cord at the T11-L1 bony level and travel in the lumbar canal as a group of nerve roots in the dural sac known as the 'horse's tail' or cauda equina. Multiple nerve rootlets that are descending in the cauda equina can be affected by a single central disk herniation or single level lumbar central stenosis. For example, a central L3-4 disc herniations

or central canal stenosis can impact the L5 and S1 nerve roots bilaterally.⁹ This anatomy poses challenges to the diagnosis of lumbar radiculopathy and locating the compression site.

The most useful test for confirming the presence of a radiculopathy is needle EMG (electromyogram). An EMG study is considered diagnostic for radiculopathy if muscles innervated by adjacent nerve roots are normal but EMG abnormalities are found in two or more muscles innervated by the same nerve root and different peripheral nerves.³ The needle EMG examination can identify only the root or roots that are physiologically involved, not the precise anatomic site of pathology in the lumbar spinal canal. This is an important limitation which requires correlation with imaging findings to determine the anatomic location of the offending site.¹¹ The most accurate imaging study to assess neural structures within the lumbar spine is MRI scanning.¹⁶ The needle EMG is helpful however, due to the high false positive rate of lumbar spine MRIs with around 30% of normal subjects having a disk protrusion.^{13,14}

Polyneuropathy is a common neurologic disorder affecting the peripheral nerves with a frequency among the general population above 5%.¹⁰ Pathophysiological changes can include: axonal degeneration, axonal atrophy, demyelization, and metabolic changes that alter nerve conduction.^{15,16} Presenting symptoms of polyneuropathy are described as pain, dysesthesias, and weakness in the feet and legs.^{17,18} Signs and findings associated with polyneuropathy are usually present with bilateral relatively symmetrical distal sensory loss, weakness, and hypoactive or absent reflexes.¹³ The sensory loss is described to demonstrate a distal-to-proximal sensory loss gradient of small or large sensory fibers. Signs of sensory loss occur in an acral, nondermatomal, nonsingle-nerve distribution. This varies from the radicular sensory loss due to it presenting in a sock distribution, rather than on the lateral or dorsal foot. Ankle jerks that are relatively depressed or absent are valuable signs of polyneuropathy.¹⁹ Motor signs may include atrophy and weakness of intrinsic foot muscles, including ankle and toe extension and flexion.

The American Association of Neuromuscular and Electrodiagnostic Medicine in conjunction with the American Academy of Neurology and the American Academy of Physical Medicine and Rehabilitation had recently recommended protocols and criteria for diagnosis of distal symmetric polyneuropathy. They determined that the most accurate diagnosis of polyneuropathy comprised of a combination of clinical signs, symptoms, and electrodiagnostic findings. These associations state electrodiagnostic findings should be included as part of the case definition because of their higher level of specificity.¹⁹

In the researcher's experience referring physicians rarely recognize and acknowledge the potential presence of a peripheral polyneuropathy in addition to a known lumbar radiculopathy. Polyneuropathy confounds the diagnoses of radiculopathy and spinal stenosis in patients known to have diabetes.²⁰ It is also our experience that a diabetic patient presenting with distal leg greater than low back symptoms is assumed to be suffering from diabetic neuropathy and the additional radiculopathy is

not acknowledged. The presenting symptoms and signs found upon examination of the distal lower extremities are similar between polyneuropathy and lumbar radiculopathy. It is important that the practicing physician be able to recognize symptoms and signs that may be indicative of an overlying polyneuropathy with lumbar radiculopathy. In order to properly diagnose the co-existence of both disorders, imaging studies, and electrodiagnostic tests are needed.

The purpose of this study is to emphasize the importance of using clinical symptoms and signs along with electrodiagnostic and imaging studies to properly diagnose a polyneuropathy with radiculopathy. The frequency of polyneuropathy being diagnosed in patients with lumbar radiculopathy who presented with low back and leg symptoms is studied. The researchers review the common clinical and diagnostic findings in these patients to provide practitioners with the identifiable combination of clinical symptoms and signs that are most indicative of an additional polyneuropathy. The complexity of diagnosing this dual central and peripheral nerve lesion is acknowledged.

Methods

Patients studied were all referred to a physician specialized in Electrodiagnostic Medicine and Physical Medicine and Rehabilitation for treatment of low back and lower extremity symptoms. The patients seen with lumbar radiculopathy were counted. These patients presented with low back pain and radicular lower extremity symptoms of weakness, numbness, and pain. All these patients had abnormal lumbar MRI findings to confirm the diagnosis of lumbar radiculopathy. Of these patients, the ones clinically suspected and then diagnosed with polyneuropathy were used as the patient sample for this study. This sample of convenience was gathered from January 2009 to October 2009 and consisted of 70 patients. All patients signed informed consent and procedures were in accordance with the Helsinki Declaration.

These 70 patients were all diagnosed with polyneuropathy based on the combination of clinical signs, neuropathic symptoms, and electrodiagnostic findings as established by the American Association of Neuromuscular Electrodiagnostic Medicine. Abnormal electrodiagnostic findings for the diagnosis included abnormal sural sensory and/or peroneal motor in one limb with additional abnormal sensory and/or motor nerve conduction findings in the contra lateral limb in a pattern consistent with neuropathy.¹⁹ Additional nerve conduction testing was completed as indicated by the pattern and severity of the abnormal findings to determine the sensory, motor, axonal, and demyelinating features of the polyneuropathy.

Reported patient symptoms at time of the initial consultation were used in this study. Neuropathic symptoms of numbness, altered sensation, and pain in the feet made by the patient were noted. The physician examined patients for clinical signs of neuropathy. Ankle reflexes were tested and graded utilizing the standard scale of normal equals 2 and absent equals 0. Pin wheel examination was used to document the pattern of sharp pin

Table 1: Presenting clinical symptoms and signs in patients diagnosed with polyneuropathy and lumbar radiculopathy (n=70)

Clinical symptoms or signs	Percent of patients Bilateral	Percent of patients unilateral	Percent without symptom or sign
Reported numbness, altered sensation, or pain in the feet	93%	7%	0%
Decreased or absent ankle reflexes	80%	5%	15%
Decreased sensation to sharp pin in feet	96%	4%	0%
Distal toe & ankle extension/flexion weakness	94%	6%	0%

Table 2: Summary of abnormal lumbar MRI findings in patients diagnosed with polyneuropathy and lumbar radiculopathy (n=70)

MRI finding	Lumbar central stenosis	Lumbar foraminal stenosis	Lumbar disc displacements
Percent of patients with finding	57%	90%	88%

sensory loss of the legs and feet. Distal muscle strength of ankle and toe extensors and flexors was graded utilizing the standard 0 to 5 grading system. Feet and lower extremities were closely inspected for evidence of muscle atrophy. Once the necessary data was collected, Excel was used to organize the data into tables.

Results

Seventy out of 255, or 27% of patients referred to the physician with lumbar radiculopathy symptoms in a ten month period were also diagnosed with polyneuropathy of the lower extremities. These 70 patients consisted of 31 males and 39 females with a mean age of 65±10.8. In these patients, polyneuropathy was suspected in addition to the lumbar radiculopathy due to a combination of bilateral distal lower extremity symptoms and bilateral distal lower extremity clinical signs.

The common clinical symptoms and signs recorded upon evaluation of these patients are displayed in Table 1. Bilateral symptoms were reported in 93% of patients while 7% reported only unilateral symptoms. The majority of signs or symptoms found were bilateral in above 90% of patients except for ankle jerks at 80%. All patients had unilateral or bilateral distal toe or ankle weakness, decreased sensation to sharp pin, and complaints of pain, numbness, or altered sensation in the feet. Exactly 15% of patients had normal ankle reflexes, but the remaining 85% had diminished ankle reflexes.

Table 2 summarizes the abnormal MRI lumbar findings in the studied patients. Lumbar foraminal stenosis and lumbar disc displacements were present in around 90% of the patients. Significant degree of central lumbar stenosis was reported in slightly over half of the patients. Central stenosis was less common than foraminal stenosis or disk displacements.

Table 3 presents the common abnormal EMG/NCS (electromyogram/nerve conduction study) findings from electrodiagnostic testing of the patients in the study. Abnormal EMG/NCS findings tended to be bilateral. Sensory sural and EMG abnormalities were the most common followed by peroneal motor abnormalities, and F wave abnormalities were the least common.

Discussion

The findings of this study verify that the combination of bilateral distal neuropathic symptoms and multiple bilateral clinical signs are the best clinical indicators of additional polyneuropathy in a patient with lumbar radiculopathy. All patients complained of distal neuropathic symptoms of numbness, altered sensation, or pain in their feet. The clinician found decreased sensation to sharp pin and weakness of the distal leg in all patients. Overall, the data states that bilateral distal foot signs and symptoms are the best indicators of an additional polyneuropathy. Precisely 93%-96% of the patients reported bilateral foot numbness or altered sensation, had bilateral decreased distal sensation to sharp pin, and had distal muscle toe extension or flexion weakness. Since radicular leg and low back symptoms were often the primary chief complaint of these patients, the bilateral rather than unilateral clinical findings and signs are crucial in the recognition of the additional polyneuropathy.

Reviewing the symptoms and clinical findings associated with neuropathy and radiculopathy is helpful in the diagnosis of both conditions. Frequently described sensory symptoms with neuropathy include bilateral numbness, burning, prickling paresthesias, dysesthesias, and allodynia involving all toes, both feet, and distal legs in a sock distribution.¹⁹ The sensory symptoms and findings associated with lumbar radiculopathy are usually unilateral and in a single nerve root pattern starting above or

Table 3: Summary of abnormal EMG/NCS findings in patients with diagnosed polyneuropathy and lumbar radiculopathy (n=70)

NCS/EMG Finding	Bilateral findings	Unilateral findings	Percent of patients without finding
Abnormal sural sensory	86%	11%	3%
Abnormal peroneal motor	76%	13%	11%
Abnormal F waves	66%	4%	30%
EMG abnormalities	84%	16%	0%

just below the knee and radiating down into the foot. The pattern of sensory loss and paresthesias is over the medial aspect of the calf, ankle, foot, and 1st toe with L4 radiculopathy; lateral knee to anterior ankle, dorsum of the foot, and lateral (2nd-5th) toes with L5 radiculopathy; and lateral mid-distal leg to lateral foot and 5th toe with S1 radiculopathy.³

If there is significant weakness secondary to the neuropathy, it initially manifests as distal and bilateral weakness during extension and flexion of the 1st and lateral toes. Weakness will progress up the feet and result in weakness during ankle dorsiflexion and plantarflexion. However, the weakness from a lumbar origin is in a radicular pattern and most commonly unilateral. Lumbar weakness will often involve proximal hip and thigh muscles. This is because hip flexors and adductors along with knee extensors are L2, L3, and L4 innervated while hip extensors and abductors and knee flexors are L5, S1, and S2 innervated. It should also be noted that weakness from L4 and L5 radiculopathy results in weakness of ankle dorsiflexion and 1st toe extension. S1 radiculopathy, however, will most commonly result in weakness of ankle plantarflexion and 1st toe flexion. L5 and S1 lumbar radiculopathy can both result in weakness of lateral toe extension and flexion.³

With lumbar radiculopathy, the radicular sensory and motor findings are most commonly unilateral and associated with specific muscle stretch reflex abnormalities of the involved side. S1 radiculopathy results in a reduced or absent ankle jerk reflex. L5 radiculopathy results in alteration of the internal hamstring muscle stretch reflex. An abnormal knee jerk reflex is associated with L3 and L4 radiculopathy. Neuropathy, however, initially results in bilateral reduced and then absent ankle jerk reflexes. The neuropathy then progresses to bilateral alterations of knee jerk reflex and internal hamstring muscle stretch reflexes.²¹

The authors have found using a physical examination template to document the clinical neurologic examination findings to be very helpful in evaluation of patients. By using a template, all abnormal findings from the physical examination are systematically documented for analysis. Plotting the exact distribution of reported abnormal sensations to sharp pin and touch on an anterior and posterior drawing of the body allows clear representation of where the abnormal sensory patterns are present. Grading and recording muscle strength during: hip abduction, adduction, flexion, and extension; knee extension and flexion; ankle dorsiflexion and plantarflexion; and 1st and lateral toe extension and flexion are recommended. Ankle, knee, and hamstring reflexes should be graded and recorded. Posture, need to support the trunk throughout the evaluation, gait alterations, and ability to squat, stand, and walk on toes and heels are important to note. An ideal template would also include evaluation for distal muscle atrophy and edema, skin discolorations, pulses, straight leg raising test, and foot deformities such as hammer toes, pes planus, and pes cavus. All abnormal findings from this assessment can then be analyzed. Focus should be on whether the abnormal findings are in a radicular or neuropathic pattern to correctly diagnose lumbar radiculopathy, polyneuropathy, or polyneuropathy with lumbar radiculopathy.

Out of a ten-month sample, 27% of the patients referred to the physician with lumbar radiculopathy were diagnosed with polyneuropathy. The possibility of an additional polyneuropathy should be considered in patients with lumbar radiculopathy when bilateral distal neuropathic symptoms are described and physical examination reveals bilateral distal loss of sharp pin sensation, bilateral distal leg muscles weakness, or abnormal ankle reflexes. If these clinical signs are found in a patient with low back and neck pain, the practitioner should proceed with electrodiagnostic and imaging studies to properly diagnose and treat the polyneuropathy and radiculopathy.

Lumbar MRI imaging revealed varying severity and locations of lumbar pathology to associate with the radiculopathy. Foraminal stenosis and disc displacements were present in nearly all the patients. Central stenosis being present in only 57% of patients strengthens the concept of bilateral signs and symptoms being viable indicators of additional polyneuropathy. Some of the bilateral symptoms could be due to central stenosis. However, the central stenosis could only account for around half of the bilateral symptoms, assuming all incidents of central stenosis caused bilateral symptoms. Overall, literature agrees that the most accurate imaging study to assess neural structures within the lumbar spine is MRI scanning.¹⁶ Correlation of the abnormal lumbar MRI, clinical symptoms and signs, and findings from electrodiagnostic studies is ideal in the diagnosis of lumbar radiculopathy and polyneuropathy.

The data indicated that EMG abnormalities, sural sensory abnormalities, and peroneal motor abnormalities are the best indicators of a polyneuropathy. These findings are consistent with previous literature.¹⁹ Electrodiagnostic studies with EMG/NCS testing are essential for the definite diagnosis of both the polyneuropathy and radiculopathy. Two recent multicenter studies have shown that EMG testing of paraspinal muscles with six to eight other properly chosen muscles in each lower extremity increases the detection of radiculopathy to 96% to 100%. EMG findings of a radiculopathy are described to have a higher level of specificity and are considered diagnostic for radiculopathy.^{3,11,19}

If the EMG/NCS initial testing yields abnormal findings, additional testing is needed for proper classification of the polyneuropathy into sensory, motor, axonal, or demyelinating. The proper selection of muscles and nerves for the EMG/NCS testing and interpretation of the recordings for proper diagnosis and classification of radiculopathy or polyneuropathy require the expertise of a well trained physician. It should be noted that non-physicians perform 17% of the EMG/NCS studies in the US.²² A past study consisting of 6381 diabetic patients undergoing electrodiagnostic testing demonstrated that neuropathy identification rates were six times higher for physiatrists, osteopathic physicians, and neurologists versus podiatrists and physical therapists performing testing despite controlling for case mix differences. These findings state the need for well trained physicians to accurately diagnose patients with these complex cases of polyneuropathy and radiculopathy.^{3,23}

When these conditions present together, both the radiculopathy and the polyneuropathy need to be treated in order to assure optimal recovery. Each of these conditions alone can result in disabling lower extremity symptoms. The diagnosis and treatment of an additional polyneuropathy compounding the lower extremity radicular symptoms is crucial. The researchers suspected that an overlying polyneuropathy further exacerbated the central radiculopathy in the group studied. If bilateral symptoms and signs are present, the patient should receive electrodiagnostic and imaging tests to confirm the diagnosis of radiculopathy and polyneuropathy.

Once polyneuropathy is diagnosed, work-up for treatable causes of the polyneuropathy with screening laboratory testing is currently recommended, even in patients with a known cause, such as diabetes. In one trial, 55% of patients with a diagnosis of diabetic polyneuropathy ultimately were found to have additional etiologic or contributory factors.²⁴ Common causes of polyneuropathy include: autoimmune disorders, chemotherapy, infections, inflammatory nerve disorders, malignancies, medication induced, nutritional deficiencies, renal disorders, and toxic exposures.²⁵ Treatment of both the radiculopathy and polyneuropathy are needed for optimal patient improvements. Recognizing the initial clinical signs and symptoms of a polyneuropathy and radiculopathy is the first step in assuring the patient receives optimal care and recovery.

Conclusion

Diagnosis of both conditions is helpful for the patient and physician in understanding, monitoring, and treating the polyneuropathy and radiculopathy. Practitioners need to be aware that the presenting symptoms may be coming from either or both the polyneuropathy or radiculopathy. Proper diagnosis of both conditions requires the recognition of peripheral and central signs and symptoms associated with the dual diagnosis of lumbar radiculopathy and polyneuropathy. The study showed the reliable indicators of additional polyneuropathy are bilateral signs and symptoms including: reported bilateral numbness, altered sensation, or pain in the feet, bilateral distal loss of sharp pin sensation, bilateral distal leg muscles weakness, or abnormal ankle reflexes. Once the initial clinical signs and symptoms are recognized, the patient should receive imaging and electrodiagnostic studies to confirm the diagnosis and describe the nature of the polyneuropathy and radiculopathy. Diagnosis and then treatment of the etiologies of both disorders will yield optimal patient improvements and reduction of future disability.

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